Annex1.

Anti selfie mechanism design for smartphone MDs through Cellulare

We strive to launch the action we called "anti selfie mechanism design for smartphone MDs". The idea behind the action is to combine modern technology and pro-ecological design, in order to improve the work of healthcare.

Specific Cellulare Motivation

It is obliged to perform some analysis on rational decision making before starting the business model for Future Lanthan Hospital. As we are dedicated to implement this model in Poland at first, we need to have broad access to medical data, which will allow us to make first estimation of the costs. Another step will be providing more detailed law and environmental analyses. Therefore, we would like to encourage individual MDs, healthcare institutions and high-tech companies to reveal some data and to cooperate in our action 'Anti selfie mechanism design for smartphone MDs through Cellulare'.

According to what was presented in previous paragraph, we intend to educate medical community (and also the whole society) on synthetic biology, open source science, data structurisation and optimal allocation of resources by mechanism design. We also aim at changing the mental attitude to data analysis and show some benefits of open access to information. We intend our action to be supported by healthcare tech companies. Thanks to this we hope to gain some valuable data and contribute to better understanding of economical, legal and social context of transition to more open society. That knowledge would be useful in

implementation of our project, especially by cooperation with members and Alumni of the program 'Leaders of healthcare market', supported by Lesław Paga Fundation 2065.

The plan for the action:

First Stage: targeting society - to match patients with their real needs

We would like to show beneficial changes for society, resulted from implementation of modern technologies in medicine, by educating people about applications, safety and some security problems related to cutting-edge technologies.

We need to find answers for following questions:

- what is the attitude of the society to smartphone based diagnostics?
- what is the attitude of the society to other lanthanide-based technology?

Surveys are to be performed before and after our educational action.

Second Stage: targeting medical community to match MDs with their real needs

We would like to educate MDs about modern technologies in medicine to show the potential of synthetic biology and modern economic concepts, which should facilitate cooperation of medical community with both science and business.

By educational action for medical professionals we hope to estimate:

- How many MDs are using smartphones and tablets for professional purposes?

- How many MDs would like to use smartphones and tablets in hospital for professional purposes?
- Which lanthanide-based technologies they would like to use?
- What is MDs attitude to synthetic biology and modern economic concepts?

Surveys are to be performed before and after our educational action.

Third Stage: Targeting medical companies with their needs

We would like to cooperate with the companies to increase the range of their recipients and to extend the market for them by taking into account the real needs of patients and MDs.

We would like to obtain following data from tech companies:

- Which lanthanides and their alloys are used in medical devices?
- What are the production and exploitation costs of some lanthanide-based devices (and the usage of tharapies requiring lanthanides)?
- What is the source of lanthanides?
- What is the demand of health tech companies for rare earth elements?
- How the demand is going to change in the future?

Our goal and desired effect:

We would like to find the answer to the questions concerning the role of lanthanides in development and implementation of mobile technologies in medicine. This knowledge would contribute to broader analysis of the usage of mobile solutions by healthcare market in Poland.

We aim to estimate what is the potential cost of equipping Polish MDs with smartphones and tablets with integrated diagnostic software. Moreover, it might be interesting to know if that solution is cost-effective or not. Similar estimations could be done for

lanthanide-based technologies. However, the major challenge would be to estimate both current and future demand for such technologies.

Anex 2.

Estimation of potential gains from Kidney Paired Donation and comparative analysis of national and worldwide transplant law to facilitate implementation of a pilot KPD program in Poland.

Keywords: kidney paired donation, transplantation law, matching theory

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Kidney paired donation (KPD) has emerged as an innovative option for recipient and their incompatible donor to be paired with another donor and recipient. Usually exchange involves two pairs; however longer cycles are also possible. The algorithms to optimize the use of live donor organs (see Figure 2) has revolutionized the way kidney transplants are performed in the USA. Modified top-trading-cycles algorithm has been used for solving optimal allocation problem for kidney exchange in longer cycles. This was to ensure the maximal number of transplant taking into account the compatibility between donors and recipients. If we want to optimize matching to ensure the highest number of conducted transplants it can't be achived in random way – as each mach do means – algorithms support the process and ensure optimal choice. The growing source of transplantable kidneys is achieved by construction a national KPD system operated by the Organ Procurement and Transplantation Network, administered by United Network for Organ Sharing. Several other countries has been attempting to implement KPD, however exchange does not take place on a large scale. The negligence is attributed to the strictness of law and the absence of economic analysis of the situation. So far no such program has been launched in Poland.

Aim of the study: The main aim of the study was to estimate potential gains from introducing KPD, point out legal barriers and propose changes in transplant law to pave the way for constriction of KPD program in Poland.

Material and methods: The study consists of two parts: model developed on the basis of medical data and a comparison of Polish transplant acts with global regulations. In the first part we run a simulation (figure 1) in which we draw a sample of patients and donors (along with their relevant characteristics) using available data, including Poltransplant data, to calibrate the parameters of the distributions (tabele 1). To reflect recipient-donor complabilty we use PRA (percentive reactive antibody) parametr. Then for a given database of patients and donors we check how many transplants would be conducted under different regimes (cycles of 2, long cycles, stable matching and benchmark). As the baseline regime we use the system that is currently being used in Poland. We test several different systems that allow for indirect kidney exchange using algorithms from matching theory (economics).

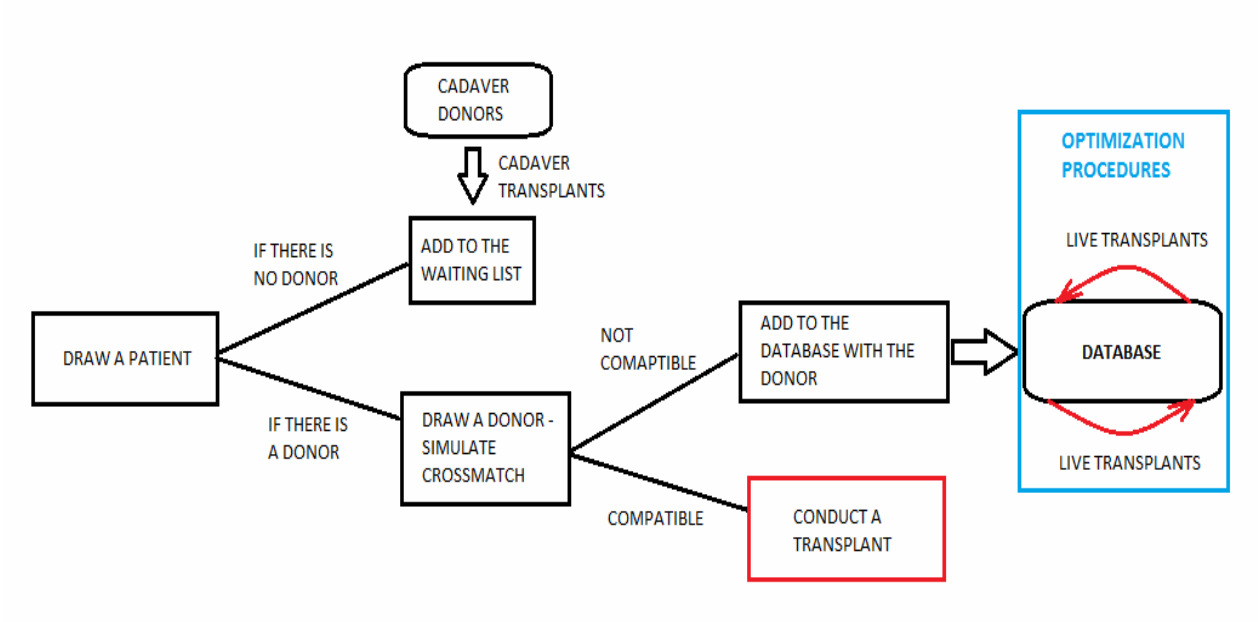


Figure 1. The model of the Kidney paired donation simulation

STEP 1: Estimate/calibrate the distributions of patients' and donors' characteristics using existing data

STEP 2. Generate (drawing from the estimated distributions) a database of patients and donors

STEP 3. Compute the number of transplants conducted in different systems

STEP 4. Repeat step 2) and 3) N times (where N is large)

Compute the average number of transplants in every system

Table 1. Simulation with medical data, including Poltransplant raports.

Name of variable	Estimation methodology	Results
Age	Method of moments (assuming lognormal distribution)	Lognormal with μ=3.8 and σ=0.32
PRA	Simulation to match moments (assuming the distribution is a mixture of uniform distributions)	Uniform on [0, 0.5] with prob. **0.94** Uniform on [0.5, 0.8] with prob. **0.04** Uniform on [0.8, 1] with prob. **0.02**
Blood Type	Directly from data	-
Probability of having a donor	Simulation to match data	**Prob. 0.05**

Results: preliminary results from Monte Carlo simulations indicate that the gains from using pairwise kidney exchange are huge - it can lead to more than doubling of the number of conducted transplants (table 2). Interestingly because of less differences in PRA distribution for poilsh population compared to American population which characterize more versatile PRA, gains from cycles of length two may ensure increase in the number of conducted transplants similar to those achieved with stable matching algorithms in longer cycles of transplantations. This is good news as this mean that implementation of KPD in Poland could be even more cost effective then in USA as transplants with shorter cycles requires less surgery rooms available and less complicated is the system enabling conducting transplants between transplant centers in different regions of country Also law procedures are easier to introduce. Here we would like to add that adaptation of Charlie W. Norwood Living Organ Donation Act could facilitate launching of KPD program in Poland. In the end, there is one more interesting observation that even if the probability of heaving a donor increases, number of conducted transplant is going to constitutively increase with KPD (Figure 2). Those encourage to launch such program in Poland to ensure more transplants.

Table 2. Potential gains from KPD in Poland assuming different allocation systems.

Method	Average number of live donor transplants (for a database of 2600 patients)	Average relative gain in live donor transplants
LONG CYCLES	**103**	**2.5**
CYCLES OF LENGTH 2	**90**	**2.2**
STABLE MATCHING	**95**	**2.3**
BENCHMARK	**41**	**-**

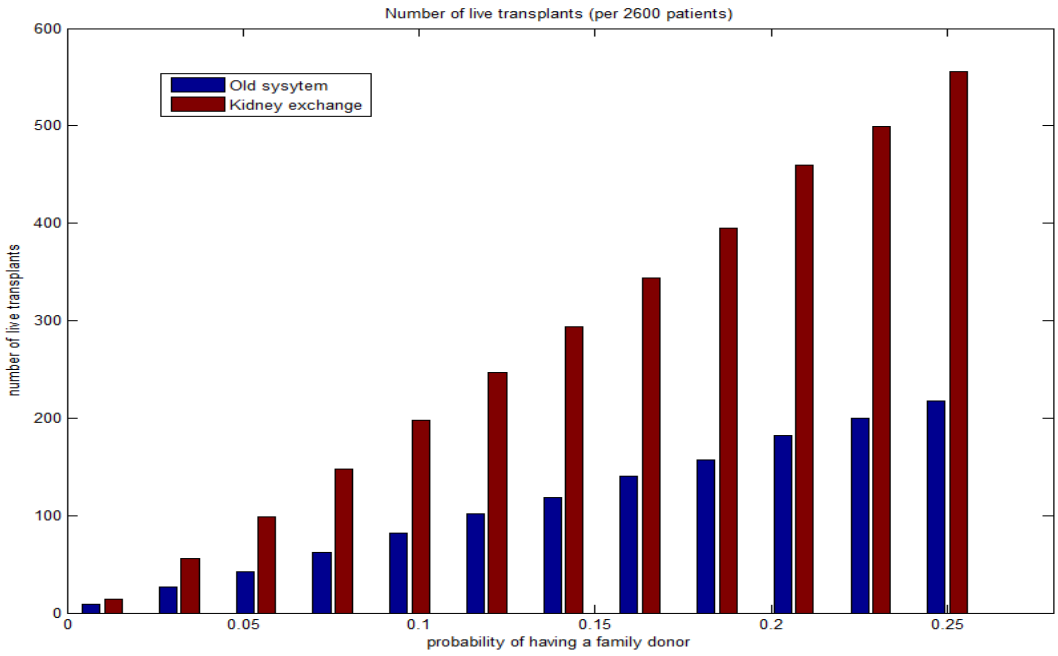


Figure 2. Effects of increasing the probability of having a donor (for the Stable Matching algorithm.

Conclusions: Our findings from the simulations are valuable for encouraging participation of polish transplant centers in the program. Establishing a national registry for paired exchange would provide more opportunities to save and enhance people's lives. The legal status of kidney

exchange in Poland requires additional records prior to the KPD implementation As a conclusion not only lack of economical and law analysis is an obstacle to implement novel heathcare programs in Poland but also lack of medical data structured in a way to facilitate building simulation models. This is way we perceive collaborate with iGEM Warsaw Team as valuable to transform healthcare for data anlysis.

Annex 3 .

Cellulare - future leaders start here

We hope to improve our model by means of cooperation with members and Alumni of the program ‘Leaders of healthcare market’ supported by Foundation 2065 im. Lesław A. Pagi and Collegium Invisible members.

Members of the program of ‘Leaders of healthcare market’ have an exceptional opportunity to attend prestigious internships in best healthcare institutions and companies in Poland. After internship completion, they would share their gained knowledge and experience with iGEM Team Warsaw, helping us to develop Future Lanthan Hospital Model. This is a way to enable people from different backgrounds (law, economy etc.) to contribute to our project.

We are also about to launch a pilot program aimed at cooperation between Collegium Invisibile and iGEM Warsaw Team members. Collegium Invisibile is an academic society in Poland, which members are outstanding Polish students working with distinguished scholars from various disciplines. The society's supreme idea is to provide a worthy contribution to the welfare and development of Polish science. An example of that attitude is the promotion of sharing knowledge and experience among students. So its idea is very similar to iGEM philosophy; Collegium also aims at offering young scholars the opportunity to participate in academic research projects as well as exclusive individual master-student cooperation through the tutorial system. Our aim is to establish mutual cooperation with the Collegium Invisible by active support of iGEM Team Warsaw projects. The first interdisciplinary project that was launched involved estimation of potential gains from implementation KPD Pilot Program in Poland. Currently, the project is further supported by iGEM Team Warsaw. The second collaborative project was aimed on organization of interdisciplinary workshops on Future Lanthan Hospital for gifted students for Polish Children’s Fund. The Polish Children's Fund is an independent, non-governmental organization. One of its major objectives is to help

exceptionally gifted pupils and students in development of their either academic or artistic skills and to adjust the educational system in Poland to accommodate the special needs of the gifted children. Members of both iGEM Warsaw Team and Collegium Invisibile wish to contributed to open creative education, hence our long term goal is to build a group of passionate students who will continue spreading our ideas in the future. In these particular cases we feel an obligation to help in STEM education in medicine and to find some future leaders to take care of Lanthan Hospital Model (and iGEM team in general). We also hope to perform several analyses related to our project in cooperation between iGEM team and mentioned organizations.

Area of collaboration:

We intend to match people with their needs, hoping that this will allow them to fulfill their ambitions and develop their potential. Hence, we do not have any fixed ideas about the nature of our possibilities - we only provide general conception. Some open questions are still left - to be developed, according to the preferences and the original ideas provided by our collaborators themselves.

Cost-effectiveness analysis

Problem 1: When our project 'Cellulare' is fully developed, we also would like to provide cost-effectiveness analysis for synthetic biology lab performing our project. We will provide estimation of the cost of materials and equipment required to finish the project. After the development of the industrial process, a comparison of costs between our methods and existing technologies would be necessary. Support from people having economic background will be appreciated.

Support: by students with economic background.

Law analysis

Problem 1: Important question is how to adjust the regulations necessary to integrate synthetic biology lab with hospital? Is it possible to just establish a synthetic biology lab in the hospital or are there any additional requirements which need to be fulfilled?

Problem 2: Do we need a straightforward way to introduce some legal regulation based on mechanism design in order to achieve social goal we mentioned in previous chapters? How to introduce legal regulation enforcing honest bargaining to prevent selfish behavior and ensure optimal allocation of goods?

In both cases, the support from people having an expertise in Polish law would be beneficial.

Environmental analysis - 'ecological hospital, green economy'

Problem 1: It is crucial to estimate the potential threats to the environment caused by electronic waste, especially taking into account the hospital electronics, eg. MRI. We need to discuss the environmental impact of recycling methods provided by our project.

Our Team contribution to analysis (see anex).

The analysis would be supported by people with engineering and environmental background. Also a person with economical background is needed.

Security and Ethics

Problem 1: Discussion on ethical issues (including safety) of the synthetic biology methods for medical purposes. DIY (Do it Yourself) versus common medical standards - how to meet the public's expectations about the credibility, reliability and professionalism.

Problem 2: Open flow of information versus security of personal data. New concept of medical hacker.

The debate on mentioned problems will be supported by people from humanities (Collegium Invisibile).

Annex 4.

Creative interdisciplinary education in the area of medicine - workshops

Workshops for students from “Highly gifted” program of Polish Children Fund prepared by members of Collegium Invisibile and iGEM Warsaw Team 2014 with a view to introduce idea Future Lanthan and simultaneously fascinate young people with synthetic biology and show idea of startups. Hospital workers show advanced lanthanides based techniues of visualization in oncology. We also prepared workshops on advanced visualization in oncology (molecular imaging, MRI) to show applications on lantahindes in medicine and collaboration on the boundaries of science.

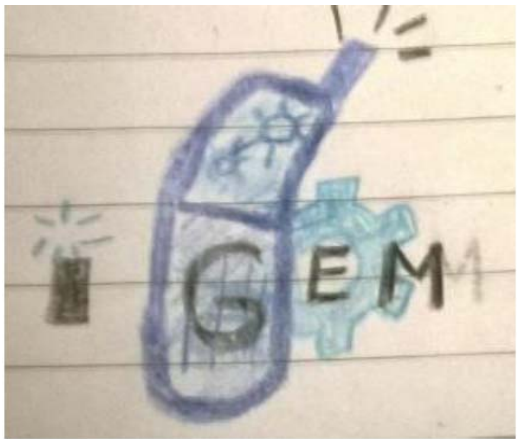
Field: Medicine**,** Synthetic biology**,** Entreprenuership

1. The Future Hospital – new technology and visionary ideas serving public health

2. ‘Visual Oncology’ – can you imagine cancer?

Photo:Piotr Migdał, used with permission

The Future Hospital – new technology and visionary ideas serving public health



All-development workshops, 27-28 April
17:00 -18:30

Anna Kornakiewicz[1,2,3] Piotr Byrski [1,3,4]

Life bits!

To ensure best healthcare possible, the doctors need the best technology available. Mobile medical devices, applications, software andhardware revolutionize the view of a hospital. These days, with the aid of IT you can evaluate the heart function and image lungs as swift as you check your email!

Day 1. What is this ''Future Hospital"? –discussion about existing solutions. We will talk about some of the already active medical start-ups. (**Quantitative Healthcare**: medical devices like stethoscope, ultrasonograph–all smartphone-synchronizable, **Biomeme**: smartphone medical laboratory, **Nanthealth**: a clinical system based on cloud computing etc.) We'll end the day with a short introduction to our plan for Day 2.

Day2. Harder, better, faster, stronger. We are already exicted for **your visionary ideas!** We will discuss them together. We willalso describe two ofour start-up ideas, one ofwhich is the **Future Lanthan Hospital**–a hospital modernized by technology based on lanthanides, which is a start-up project of the iGEM* Team Warsaw2014.That means: how to get raw materials to assemble smartphones and medical devices and how to make them further and more usable for doctors and patients.

For whom?

For people wishing to get their ideas implemented quickly! For those into healthcare issues, new technologies, smartphone and tablet users. For all of you –to discuss and create ideas, we are going to need people with different backgrounds that like critical thinking and rapid prototyping!

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***iGEM**-International Genetically Engineered Machine –is a synthetic biology competition taking place at theMIT (Massachusetts Institute of Technology). The main idea is to design''living machines"(Biobrick), using geneticengineering.It is addressed to young scientists(high school/university students), who want to enter the rapidly developing world of synthetic biologyand contribute to its development suggesting new solutionsto make people's lives better with programmed biological machines.*

1. Collegium Invisibile 2. iGEM Team Warsaw2014 3. Medical University of Warsaw4. The College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences, University of Warsaw

‘Visual Oncology’ – can you imagine cancer?

Anna Kornakiewicz*

Interdisciplinary workshop, 12 am-1.30 pm, April 25-27th

Medicine is an information science and art of healing

There are many techniques of biomedical imagining used at every stage of diagnostics and treatment of tumours, but also during developing new treatments. Bioimagining is a key part of clinical protocols in oncology, providing structural, metabolical and functional information. Integration of imagining and other types of data helps in taking clinical decisions, but also requires cooperation between doctor, biologist and IT specialist, even visualization specialist and data analyst.

To see and understand

We will use visual data in order to understand what a cancer is and what a cancer specialist (oncologist) does. We will also try to answer a question why medicine is both information science and art of healing.

The goal of the workshop is learning how to analyze visual data and understanding the role of information in medicine, how to think of medical data and how to use them in treatment, research and science.

1st clinical day: clinical mems

Workshop of interpretation of RTG, USG, CT, MRI etc. (hopefully afterwards everyone will be able to show off in front of their grandparents ☺). There will also be an interesting clinical puzzle about use of visual data on every stage of detection and treatment of cancer.

2nd molecular day: next dimension of cancer

(more advanced bioimaging techniques in oncology – molecular biology’s and medical data integration workshop)

Tasks showing:

- How and why to create spatial body map?
- How to see cancer stem cells, development of blood vessels and gaining drug resistance on bioimaging photographies?

3rd interdisciplinary day: metavisualisation – how to see and understand the beauty of medicine?

(about the first audiovisual system to teach medicine)

- Playing with the application,
- Talk about visualization of data in oncology,
- Creating a project of visualization for interactive system, using knowledge from previous workshops.

For who?

For everyone interested in medicine and molecular biology, who would like to get a glimpse of cancer in different dimension, but also for people from exact sciences, who are interested in the use of data and for artists, humanists and anyone looking for inspiration!

Useful knowledge: seeing, understanding, a little imagination and a lot of enthusiasm!

*Warsaw University of Medicine, Collegium Invisible, member of iGEM Team Warsaw